PEST TECHNOLOGY
Pest Control and Pesticides

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CONTENTS

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Back Again!

BACK AGAIN—we are sorry for the absence of our July issue, but no doubt readers will be aware that this was unavoidable. Some journals produced emergency editions, some good some not so good, however, all did their best and we appreciate their determination and desire to publish in some form or another. For various reasons, which would take too long to discuss, we preferred to hold on until we could produce an issue of the usual standard.

This issue will be entitled " Pest Technology, Pest Control and Pesticides, Volume 1, July-August, 1959, Numbers 10 and 11. We would hasten to add that this is solely for reference purposes.

However, the absence of " Pest Technology " does not prevent the activities of pests, therefore the battle against pests must continue. Consequently news still occurs and like time and tide, will not await our convenience. Naturally there is now a " pile up " of information at our offices and we have experienced some difficulties in allotting space to the various items. Some will appear old and out of date to certain readers and yet it remains news to many because of the absence of several publications, including our own. Several news items have been whittled down to the bare essentials and others have had to be excluded. We regret this necessity and hope that firms and agencies will continue to send us items of interest.

Important events that have occurred in our absence include the fine weather or rather the results of it. Due to the prolonged spell of warm weather pest populations built up and in some cases reached epidemic proportions. Insects threatened the sugar beet crop and, had it not been for the use of aerial spraying, great losses would have ensued—a fact that was even noted in the National Press. Only because a large area can be sprayed in a short time by the use of aircraft, was the sugar beet crop saved from devastation. Even then the crop may have been in danger had it not been for the rapid organisation, by Baywood Chemicals, of an " air-lift " to import " Metasystox " from the Bayer works in West Germany. We believe that facts such as these justify the publicity which we have given in, previous issues, to aerial spraying.

Progress is being made by several firms, particularly overseas, regarding the control of warble flies and other ectoparasites of livestock. This branch of pest control is of particular interest and we have been following several reports from overseas concerning the use of these " cattle grub systemics." In trials a number of chemicals have shown promise, including Co-Ral,Trolene (based on Dow ET/57), Dowco 109, Dimethoate, Neguvon (Bayer L13/59), and we await the day—believed to be in the near future—when " cattle grub systemics " will be put on the market in this country.

The Problem of Insecticide Resistance

By JAMES R. BUSVINE, D.Sc., Ph.D.,

(*Reader in Entomology as Applied to Hygiene, London School of Hygiene and Tropical Medicine.*)

Photograph taken at the Public Health Inspectors Week-end School at Clacton held prior to the Royal Society of Health Congress. A group of interested inspectors including Mr. H. C. Reeve and Mr. S. A. Eade of Harlow U.D.C., Mr. G. Walshaw of Guildford M.B., Mr. L. A. Croft of St. Albans City, Mr. R. Mahoney and Mr. R. L. Davis of Lewisham, Mr. C. Willard of Feltham U.D.C., Mr. R. C. Charlton of Bermondsey and Mr. H. G. Stephenson of Hackney gather round Dr. J. R. Busvine as he indicates an interesting specimen from his case of mounted insects following his lecture at Clacton.

The following account is an abstract of the paper delivered to the Royal Society of Health Congress, 1959, in the Symposium on Insecticides and Public Health.

THERE should be little need to emphasise the seriousness of the threat presented by the emergence of strains of insects immune to the newer insecticides. This trouble is at present much less evident in Britain than in hotter parts of the world owing to our much more sparing use of insecticides.

Beginning with DDT resistant houseflies in 1947, resistance has occurred in 30 different insects of public health importance, involving every important genus in this field with the exception of *Phlebotomus*, *Simulium* and *Glossina*, and involving all the well known groups of insecticides even the pyrethrins.

While it is true that resistant strains have appeared in nearly all insect genera of public health importance, the number of species involved is still only a moderately small proportion. Often too the trouble is restricted to certain localities and may not extend over the complete range of a particular species. In nearly all cases, resistance is shown to particular types of insecticide only, so that it is still possible to find an alternative choice of chemical control. The real importance of the matter is the continuous growth of the problem and the fact that in no case have we been able to overcome resistance where it has arisen.

Unlike bacteria, there is no question at all that the resistance mechanisms of arthropods could have developed as a direct response to the poisons used. There is no evidence that sub-lethal doses of insecticide are capable of stimulating mutations and the emergence of resistant strains seems to be due to the effect of selective mortality on pre-existing genes.

It seems reasonable to presume that the speed with which the resistant strain will come to replace the normal insects will depend on two factors: (i) the prevalence of individuals possessing resistant genes in the original population and the nature of these genes (single or multiple, dominant or recessive); (ii) the intensity of selection pressure due to the insecticide.

Over the years evidence on the prevalence of resistant genes has shown that the potentiality is widely dispersed

in the arthropod kingdom. This, however, does not necessarily mean that every species is capable of producing resistant strains. Indeed it is quite possible that some species which are widely distributed may be capable of developing resistance only in limited areas.

Considering the genetic mechanism involved, if resistance is dominant, heterozygous specimens will survive exposure to insecticide and resistance will develop rapidly. On the other hand, if resistance is recessive, the heterozygous individuals will be easily killed and the strain will take much longer to get started. However, once it has developed it should show greater stability, since it will more rapidly tend towards a pure homozygous resistant population.

Regarding the intensity of selection, it seems reasonable to suppose that the higher the proportion of insects killed by an insecticide, the more rapidly will the susceptible ones be replaced by resistant individuals and their progeny. There are two aspects of this selection pressure, the first demanding a highly efficient insecticide. Secondly this insecticide must be widely used; for if the application is localised, its selective effect will be diluted by the large numbers of insects which have never encountered insecticide.

It is evident that the synthetic residual insecticides must be very liable to strong selective action on both these counts. Not only are they efficient and remain so for long periods, but their cheapness and simplicity has led to their exceptionally wide use. Thus it seems likely that the great multiplication of resistant strains which followed the use of these new insecticides may be a direct consequence of their very virtues.

On the limited evidence available it is suggested that if this selection pressure is removed (that is if the use of the particular insecticide is ceased) the resistant strains, once developed, die out only very slowly.

The really troublesome cases of resistance are specific to certain types of insecticides. Four main form are known, embracing groups of insecticide which presumably have similar modes of action; (i) DDT and analogous compounds such as methoxy-chlor; (ii) BHC, dieldrin, aldrin, chlordane, endrin, heptachlor, toxaphene; (iii) organophosphorous insecticides; (iv) pyrethroids.

Nearly always, when resistance develops to any of the insecticides mentioned above, it will automatically extend to other members of the group. At the same time, the strain will normally remain susceptible to insecticides in the other groups. However, it is quite possible for an insect to develop resistance subsequently to other groups and this has already happened in strains of house-flies and bed-bugs. At present there are not many such cases of multiple resistance and this protects us from the full effects of resistance, because in most cases alternative insecticides are available. Due to our ignorance of the exact ways in which various insecticides actually kill insects the task of discovering why they fail to do so is obviously complicated.

One of the difficulties of assessing the validity and importance of reported cases of resistance was that there was no standard method of detecting and measuring resistance. The use of W.H.O. prepared test kits containing exposure tubes and all the necessary gadgets to carry out the tests, which have been supplied to field workers in many countries, helps to solve this problem for mosquitoes, human lice, bed-bugs and fleas. House-flies can easily be reared in the laboratory and therefore there does not appear to be the necessity for a standard field test.

Owing to Britain's cool and temperate climate, insect pests of public health importance are much less troublesome than in warmer countries. Consequently, the use of insecticides against these insects is mainly restricted to the irregular and transitory efforts of householders. The interest of authorities is often limited to short periods of hot weather. For these reasons there is much less pressure towards the development of resistant strains.

In the event of more energetic measures against insects being taken resistance is likely to become a problem and there is an obvious need for a central body to collect and correlate information on resistance in Britain.

THE BIOLOGICAL CONTROL OF AGRICULTURAL PESTS*

By GEORGE C. VARLEY, M.A., PH.D. (*Hope Professsor in Entomology, University of Oxford*)

THE first successful experiment in biological control occured in California where a serious pest of orange trees, the cotton-cushion scale insect (*Icerya purchasi*), had been introduced from Australia and threatened the citrus growers in California with ruin.

Alfred Koeble working for the U.S. Department of Agriculture brought back from Australia specimens of a small fly (*Cryptochaetum*) and a red and black ladybird beetle (*Vedalia cardinalis*) which were the native enemies of scale. In 1889 just over 500 live beetles (and some flies) were liberated on heavily infested trees in California and the spread of Vedalia was so spectacular that within a year it was obvious that a major success had been achieved. After a while both became uncommon, although neither the scale nor the Vedalia beetle died out. When DDT was used against an outbreak of the citricola scale quite recently the Vedalia beetle was eliminated locally and soon serious outbreaks of cotton-cushion scale were reported. With a revised insecticide programme the beetles have been re-established.

The early successes of biological control were particularly numerous in the Pacific islands and especially Hawaii, where the Hawaiian Sugar Planters' Association showed great enterprise. They were able to control three serious pests and a number of minor pests of sugar cane by the introduction of beneficial insects. In Hawaii they have scarcely needed to resort to insecticide treatment at all.

Since these early days many other pests have been successfully treated in these and other oceanic islands. The paucity of similar successes in continental areas led to the widely held view (in spite of Californian experience!) that biological control was a phenomenon restricted to oceanic islands. Clearly this could not be due to any sense of geography on the part of the beneficial insects, but might be related either to the suitability of the more equable climatic conditions, or perhaps to the agricultural practices and the level of control required by the growers. If the crop is sugar or copra, where the commercial product has to be extracted, minor damage may be unimportant. In contrast a fruit grower in the export trade must have very high standards to pass quarantine regulations and provide fruit which is free from pests, attractive in appearance and capable of being stored.

A summary of biological control in the U.S.A. by Clausen shows that there was considerable success with the control of fruit pests and some success recently with forest pests. The results with field and garden crop pests were very poor, the only two successes being the use of a parasite and virus against the alfalfa caterpillar (*Colias*) and a parasite from Italy against the alfalfa weevil. Alfalfa, like sugar as grown in Hawaii, differs from most field crops in being available throughout the year to its pests and its parasites. Perhaps it is the sequence of sowing, growing, cropping and ploughing which presents pests with a special opportunity and hinders beneficial insects from performing a satisfactory job of control?

Many of the most useful parasites of scale insect pests of fruit trees are tiny chalcid wasps. These parasites are extremely specific in their choice of scale insects, yet very difficult to distinguish from the many closely allied species. In some cases different races of the same species attack quite distinct species of scale. Clearly the greatest care must be exercised to avoid mistakes when introducing such beneficial insects.

Some fruit pests, such as the codling moth of apple, remain very serious in spite of all attempts to control by both insecticides and biological means. Human selection for greatly increased fruit size (compared with the crab apple) has put the codling caterpillar far from the reach of the ovipositors of parasites. Perhaps agricultural practice has made the codling moth a pest.

An interesting case of biological control concerns the Japanese beetle in eastern U.S.A., which feeds voraciously on ornamental bushes and trees. *Tiphia* wasps introduced from Korea have noticeably reduced the pest's numbers, but recently a new method of great promise has been used. A bacterium which causes a fatal " milky disease " of the beetle grubs has been propagated and sprayed like an insecticide.

Some of the properties required of a successful agent of biological control are well understood; but they are known for the most part only qualitatively. It is still impossible to predict quantitatively whether an introduced species will control a pest at a satisfactory level, or even to be sure that it will establish itself. In the future biological control and the use of insecticides as well may achieve their rightful place as the practical application of population science; but at the moment this science is in a very unsatisfactory state. There is a copious theoretical and mathematical literature, but the basic assumptions of the rival theories remain largely untested. The population theories which particularly concern the biological and chemical control of insect pests are those of W. R. Thompson and A. J. Nicholson.

* *Abstract from the Fernhurst Lecture delivered to the Royal Society of Arts*

Nicholson considers that parasites and predators search for their hosts or prey " at random " and their reproductive rate is determined by this food supply. He has constructed a mathematical model of the interaction of parasites and their hosts which predicts that a " Steady state " can exist in which the parasite and the host are in equilibrium. The level of this balance depends on the efficiency of the parasite in searching for hosts and on the natural rate of increase of the host. The balance is also considerably affected by both host and parasite mortality. Nicholson also predicts that the population density of both host and parasite should oscillate about the " steady density," which various experiments have now confirmed under controlled conditions.

If oscillations of population density occur, this theory suggests that when host density is high the individual parasites will lay very large numbers of eggs. In fact, the parasite egg supply is limited and, under these conditions, the theory put forward by Thompson may be closer to the truth.

Thompson criticizes Nicholson's idea that the parasites search at random and prefers to consider that female parasites distribute a limited number of eggs amongst their hosts; the consequence of this view is that a species of parasite, if introduced as an agent of biological control, may increase geometrically for some generations; this has been partly confirmed by Thompson's observations upon the parasite of the woolly apple aphis. Finally, however, the host should be exterminated; unfortunately this has yet to be observed.

Neither of these theories can be regarded as completely satisfactory but since both have in part been confirmed perhaps the truth lies somewhere between them.

The question of which of these theories, if any, is correct is not just an academic one. The decision as to which parasite or predator should be introduced as an agent of biological control, or whether one species or many species should be introduced, depends on the theory held! If Thompson is right the parasite which will be effective in the shortest time is that which can lay most eggs. If Nicholson is right the efficiency of searching by the parasite or predator, especially its ability to maintain its numbers at low host density, is the important attribute.

An important and surprising deduction from Nicholson's theory is that the host equilibrium density is lower if the most efficient parasite is introduced alone, than if two or more less efficient parasites are also introduced! This conclusion conflicts with the commonly held " sequence theory," according to which the more parasitic species that can be established the better. Believers in the sequence theory are still making multiple parasite introductions, which, if successful, are irrevocable.

Now it is common experience that wherever an insect is abundant in a continental area large numbers of species of parasite can be bred from it. Are we sure which is cause and which is effect? Are many species of insect found because the host is abundant? Or is the host a pest because it has many species of parasites? These questions are so important that it is a high time serious attempt was made to put population theory on a firm basis. *The results will affect not only biological control, but will help to put insecticide practise on a scientific basis* There is urgent need for basic research on the feeding and searching behaviour of parasitic and predatory animals, especially those used in biological control.

Practical work of biological control is severely hampered by our lack of knowledge of such insects as the tachinid flies and especially the parasitic wasps which are so largely employed. There is an urgent need for more taxonomic work on these insects. Although biological control operates on a world-wide basis, a very high proportion of the potentially useful species are as yet unknown, and many of those which are encountered can be named only to genera.

There is no doubt that these projects would be of considerable benefit to agriculture as a whole even in Great Britain where recent estimates suggest that annual losses due to pests in this country may be as high as £50 million. The proper integration of biological and chemical treatments may be far cheaper and more effective than some of the methods in current use.

Biological control has one important long-term advantage over chemical methods. Where insecticides are employed it is inevitable that the process of evolution is against us. Many pests have already evolved strains resistant to the insecticides in use. With biological control there may equally be a selective advantage in the pests' increased resistance to the parasite or predator, but there is also selection in favour of more efficient parasites and predators. Evolution is thus effectively neutral. However, in Canada and elsewhere scientists are exploring the exciting possibilities of breeding improved strains of parasites, just as we have improved the strains of animals and plants directly used in agriculture.

Biological control cannot provide an immediate remedy for a pest outbreak, even if a beneficial species is available for immediate colonisation, whilst the employment of an insecticide must have an immediately favourable effect. However, practical experience and population theory agree that immediate and long term effects may be entirely different. Progress in understanding these effects will not be possible until fuller observations of the biological relationships between crop plants, their pests, potential pests, their parasites and predators are made by specially trained scientists with a clear idea of the theoretical basis of their work.

TIMBER!

The unavoidable use of timber containing a high proportion of sapwood presents an ever increasing threat from timber destroying pests.

Observations

THE ANNUAL CONVENTION of the British Wood Preserving Association was the first which " Pest Technology, Pest Control and Pesticides " had attended. We sincerely hope we may have the pleasure of attending many more, because we found it a most stimulating experience. When one attends a function which is well organised, it makes a great deal of difference to the general wellbeing—and this Conference *was* well organised. For that, obviously, we must thank the Conference Committee and also the Secretary (Mr. Wm. E. Bruce, M.A.F.I.-W. Sc.), and his staff.

Coming now to the standard of papers, personally the writer found this a little uneven, but it is probably a good thing to have a selection of papers which appeal to everybody. There seemed general agreement that the " pictures " which Mr. E. H. B. Boulton, M.C., M.A., showed us, were nothing if not first class.

What emerged from the Conference? It would be invidious for one to begin airing one's views after what is, after all, a comparatively short time in the industry, but it did appear to the writer that there is a first-rate opportunity—and a big job—for the Association to do in respect of nomenclature. It seems clear that there must develop a standard of nomenclature, not only for this country, but overseas. Any Association which takes the trouble to try and define nomenclature is assured of support, and although the conclusions reached may not satisfy everybody, it will at least be the beginning of a move to standardise terms so that all can speak with one voice; so that there is understanding as to what exactly is meant. It appears there is no unanimity with regard to certain terms in this country, let alone between this country and overseas. It will take time—a long time—to reach this Elysium, but a start must be made.

Another point which emerged was the need for some co-ordinated approach between the industry and local authorities in respect of use of timbers for house-building. Apparently a lot of sapwood is being used in the new houses, and however much one may wish that more seasoned wood be employed, nevertheless the economics of the industry and the present set-up seem to indicate that sapwood will continue to be used. This is not so bad provided there are adequate safeguards, such as removal of bark and, may we hope, treatment of timbers before use?

One felt that there was still not enough being done by the industry to make the public aware of the position in regard to infestation. " Call in the expert " could well be a slogan to be publicised to the world at large.

It seemed that, so far as the United States is concerned, creosote is finding a challenge developing from new preservatives. This, of course, was not unexpected and in this country, too, one may anticipate such a trend. The answer, surely, is that there is room for the established and the new.

There was an underlying note of regret at the closure of the Forest Products Research Laboratory. A suggestion that this matter be discussed at the Brains' Trust session was adroitly circumvented by the Chairman of that session. Although one felt that he could not have acted otherwise, nevertheless it was clear that the majority of those present hoped for some means of giving tangible expression to their feelings.

A question which was posed by one delegate—whether in the future we should not see an increasing use of fungicides blended with insecticides—offers much scope for speculation as to the future trend. The question appeared to be asked because of the increasing use of sapwoods for house building and to which reference has been made.

Blending seems to be the order of the day: we have blends of " Terylene " and wool, nylon and cotton, silk and rayon, in the clothing industry: we have alloys in the field of metallurgy: we have fertilisers blended with pesticides in agriculture, and so it seems only logical that the suggestion may envisage a line of development for the future.

The social side was as successful as the business sessions, and the Garden Party a particularly happy function. Personally the writer would have liked to see the final " do," a dinner-dance, instead of the more formal dinner, but this of course would have pre-supposed a greater attendance of ladies. But why not? Other organisations, at their annual conferences, encourage the

delegates to bring their ladies. Special functions and trips are arranged for the ladies during the business sessions, and for the highlight—the annual dinner and dance—they add colour and beauty to an otherwise somewhat prosaic scene, and keep a party in progress instead of the inevitable drift away into private groups afterwards.

Abstracts

Boron as a Wood Preservative

By D. R. CARR, B.Sc., *Borax Consolidated Ltd., Timber Department.*

Summary

EVIDENCE of the toxicity of boron to wood destroying organism is presented along with certain concepts associated with the development of a preservative specifically for building construction.

Reference is made to the application of boron to timber by the conventional vacuum-method pressure of treatment, while diffusion impregnation is described in some detail.

Introduction

In the field of chemical protection of wood, the first and most essential requirement is that the wood be adequately protected against wood destroying insects, fungi or marine borers (depending upon the end use of the product being preserved and the economic significance of the wood destroying organisms concerned), and secondly that the cost of adequate chemical protection should be kept as low as possible.

To achieve these dual requirements, it is necessary to select appropriate preservative chemicals for specific wood uses. Indeed, it would be unrealistic to insist on the use of a preservative that would protect wood, in all circumstances, against every possible hazard. Furthermore, it would probably be uneconomic to attempt to develop such a preservative.

It has often been said that the ideal wood preservative should have the following qualities, viz:

i. Toxic to wood destroying organisms.
ii. Chemically consistent in quality, and stable.
iii. Inexpensive and plentiful.
iv. Harmless to human beings, domestic animals and plants.
v. Colourless and odourless. For some purposes colour may be specifically desired as evidence of treatment or for aesthetic reasons.
vi. Without any ill effects on materials with which the timber may come into contact, particularly food.
vii. Non inflammable.
viii. Non corrosive to metals.
ix. Resistant to leaching, evaporation, volatalization.
x. Capable of penetrating wood.
xi. Without any damaging effects on paints, varnish, polish.
xii. Compatible with glues used in wood processing.

No known preservative meets each one of these ideal requirements nor are all these requirements essential for all wood uses. In the selection of a preservative, therefore, one must take into consideration the particular conditions of service and the performance that will be expected of the treated wood.

Boron toxicity to Decay Fungi and Sapstain Fungi

Laboratory tests have shown that, up to date, no wood rotting test fungi have been found to exhibit any appreciable degree of tolerance to boron.

In connection with sapstain fungi, it has been found that the addition of borax to chlorinated phenates gives better or equal protection at lower cost than chlorinated phenates or organic mercurials on their own.

Where service conditions do not involve any serious risk of removal of boron from treated timber by leaching, the resistance of boron to treated timber is assured.

Boron Toxicity to Wood Destroying Insects

With wood destroying insects there is a wide difference between the nutritional requirements of different insects and the manner in which they attack timber, so that the standardisation of tests against insects presents greater difficulties than those encountered with wood destroying fungi.

Mr. Carr described some of the difficulties of testing and made reference to laboratory evidence, which has appeared in various publications, concerning the toxicity of boron to wood destroying insects.

Boron Toxicity to Termites

Though the earliest testing of boron treated timber indicated that it was not effective against termites, it is apparent that attack often occurred after the borates had been removed by leaching.

More recent laboratory tests have indicated that boron is effective against the intestinal protozoa of termites and that the destruction of this protozoa leads to the destruction of the termites. Boron would therefore be effective against all dry wood termites but not against all species of subterranean termites.

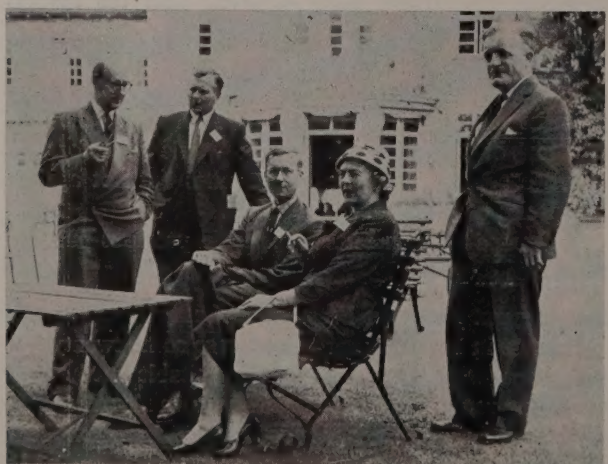
Reference to other tests reported in previous publications was given.

Development of Boron Preservation

Interest in boron preservation arose some twenty-five years ago when trying to find a suitable method of treating *Lyctus* susceptible hardwoods in Australia. It was realised that these hardwoods would make excellent plywood, if they could be made resistant to *Lyctus* attack. Research showed that boron was not only very toxic to

A view of some of those present.

T. M. Scarffe (Calders (Northern) Limited), F. M. Potter (Scottish Tar Distillers Limited), E. H. B. Boulton (Pestcure Limited), Dr. R. H. Colley (Bernuth Lemboke Co. Inc., U.S.A.), T. Gabriel (Gabriel Wade and English Limited), B. Hickson (President, Hickson and Welch Limited), J. M. Gurd (Timber Preservers Limited, British Columbia), J. D. Bletchly (Forest Products Research Laboratory), C. S. White (Ramsey, Murray, White and Ward), Dr. D. McNeil (Coal Tar Research Association), W. E. Vesey (President, Timber Trade Federation of the United Kingdom), C. J. Ady (Hickson's Timber Impregnation Co. (G.B.) Limited).



W. A. Robinson (Midland Tar Distillers Limited), W. R. Saunders (Midland Tar Distillers Limited), Dr. V. R. Gray (Timber Development Association Limited), Mrs. J. Bayley Butler (Biotex Limited), E. Wood (Crosby and Company Limited).

this particular insect, but that the rate of diffusion of boron into veneers was rapid. Treatment of both veneers and sawn timbers with boron, by diffusion, was developed even further. By 1945, the commercial treatment of *Lyctus* susceptible hardwoods in Australia had been perfected and was successfully conducted on a large scale. The Governments of N.S.W. and Queensland passed the N.S.W. and the Queensland Timber Marketing Acts. For the first time the law required the treatment of timber by certain approved processes. Boron treatment was one of the approved processes. Very soon all *Lyctus* susceptible woods used in Australia were being treated, almost exclusively with boron because of its low cost, low toxicity to human beings, and high toxicity to the insect against which protection was specifically desired and also because it could be applied by diffusion.

Pressure Impregnation

The most extensively used method of preservative treatment involves placing air dried timber in a special treating cylinder. The preservative chemical is then impregnated into the wood by artificially created liquid pressures. This method of treatment has demonstrated its value over a period of many years and is frequently used for boron preservation.

Non-pressure Processes

Adequate absorptions, deep penetrations and even distribution can be obtained by certain " non-pressure " methods that are commonly used with borates are based essentially on diffusion impregnation which involves two distinct steps, namely, dipping and storage. The process is not limited to dipping timber in a chemical solution.

Diffusion Impregnation

Diffusion impregnation occurs essentially through the " free water " in the wood cells of " green " timber.

When freshly sawn " green " timber is immersed in a solution of chemicals, there is a difference in the concentration of chemicals in the solution outside the wood and the water in the wood cells. Dissolved chemicals therefore tend to move from the surrounding solution into the " free water " in the wood cells. Diffusion continues so long as differences exist between the treating solution and the water held by the wood cells. This diffusion continues until the concentration of chemicals contained in the water of the wood cells is evenly distributed throughout the wood and complete penetration is obtained. In commercial practice diffusion is arrested at an appropriate stage by drying the timber.

The higher the proportion of wood substance, the lower the water holding capacity of the wood vessel and here a higher solution concentration is required for effective treatment. In other words, the denser timbers (containing less " free water ") generally require high treating solution concentrations.

There are considerable variations in the rate of diffusion from one species of timber to the next and also within any one species. Factors governing diffusion of solute into timber are complex.

Commercial Methods of Diffusion Impregnation

Diffusion Impregnation involves two distinct phases:

(a) The requisite quantity of preservative is first introduced into the periphery of the green timber.

(b) The treated timber is held under retarded air-drying conditions, so as to enable the chemical to diffuse and distribute itself throughout the cross section of the wood.

Steaming-cold Quench

This process, which is suitable for partly dried timber, involves subjecting timber that has been open piled to a preliminary steaming in a chamber. After steaming at about 85^{0}C. for a few hours, the chamber is flooded with a 2% to 3% boric acid equivalent solution at ambient temperatures. The timber is submerged in this solution for about 14 hours. During the quenching process the treating solution is sucked into the heated timber and further quantities of chemicals diffuse into the wood during immersion. Treated timber is stored under retarded air-drying conditions for 10 to 14 days, when complete penetration is obtained.

The " Hot Immersion " Method

In this method of treatment the preservative enters the green timber entirely by diffusion from a heated solution in which it is immersed for a few hours. As a rule, solution concentrations of 3 to 9% boric acid equivalent are used, while immersion times vary from 2 to 4 hours for one inch timber.

To ensure that the correct solution concentration is in contact with the timber surfaces, the timber must be open piled and the solution agitated. After treatment the timber is held under retarded air-drying conditions for complete penetration to occur.

The " Momentary Immersion " Method

Similar in principle to the to the " Hot Immersion " method the differences being that the immersion period lasts a few seconds and solution concentrations of 30 to 40% boric acid equivalent are used. The green timber may either be dipped in the treating solution for a few seconds or the solution may be sprayed on the timber. seconds or the solution may be sprayed on to the timber.

" Momentary Immersion " treatments allow the timber to be block stacked. The temperature does not play an important part in diffusion but serves to keep the chemicals in solution. Diffusion storage requirements are similar to those of the hot immersion method.

Identification of Boron Treated Timber

Boron treating solutions are colourless, therefore boron treated timber retains its natural colour, which is an advantage where the wood is to be used for furniture and other decorative purposes.

Treated timber can be easily recognised by means of a simple spot test or a dye can be added if required.

Preparation and Chemical Control of Treating Solutions

Where solution concentrations of 8% to 9% boric acid equivalent are used, hydrometer readings are generally unreliable and the concentration is checked by simple methods of quantitative analysis.

The treating solution concentrations required by momentary immersion are generally 25% to 40% boric acid equivalent and these concentrations are well above

Dr. D. R. Carr (Borax Consolidated Limited), I. R. C. McDonald (New Zealand Department of Scientific and Industrial Research), W. Rothwell (British Railways), and D. Montgomery (Borax Consolidated Limited).

W. Ward (Standard Telecommunications Laboratories Limited), Mrs. D. I. Boulton (Pestcure Limited), Capt. J. Haryott (Ministry of Supply), E. H. B. Boulton (Pestcure Limited), B. Richardson (Richardson and Starling Limited), Brig. H. C. J. Yeo (Burt and Haywood Limited), S. A. Richardson (Richardson and Starling Limited).

A. Fraser (Protim Limited), D. Montgomery (Borax Consolidated Limited), W. H. Westphal (Disinfestation Limited), C. S. White (Ramsey, Murray, White and Ward), E. M. Buchan (Rentokil Limited), D. Boocock (The Standardised Disinfectants Company Limited), J. G. Attfield (Shell International Chemical Company).

the maximum solubilities of boric acid or borax. However, by using boric acid and borax together, so that 1 part of boric acid is dissolved with 1.54 parts of decahydrate borax (or 1.18 parts of pentahydrate borax) high solubilities are readily obtained.

A product has been specially developed for timber preservation which gives the desired boric acid/borax ratios in a single compound. The use of this product makes the technique of solution preparation as simple as possible.

Operation temperature for " momentary immersion " plants should be between 40°C. and 60°C. No useful purpose is served by temperatures outside these levels.

Conclusion

Laboratory tests have demonstrated the toxicity of boron to wood destroying organisms of economic significance in building construction and commercial experience has substantiated these laboratory findings. For these end uses where treated timber is not exposed to serious leaching hazard, boron meets the requirements of an effective preservative. In addition, boron can be applied to timber by conventional methods of pressure impregnation or by simple " non-pressure " methods. It is a basic chemical which is plentiful, inexpensive and readily available and it has logical applications in the general field of chemical wood protection.

The Fine Structure of Wood with Special Reference to Timber Impregnation

By R. D. PRESTON, F.R.S., *Professor of Plant Biophysics, Botany Department., University of Leeds.*

Introduction

THE skeletal material of wood around which the other substances are deposited is undoubtedly *cellulose*. This substance has been considered to consist of long molecular chains of glucose residues joined together in the chain by primary valences with no other sugars present and with no substituent groupings on the residues other than the occasional carboxyl groups. As a result of a recent investigation of the chemical composition of celluloses from varied sources (Cronshaw, Myers and Preston) it is now possible that this assumed structure represents only an approximation.

Although surrounded with various encrusting substances such as pectin, lignin etc., cellulose is the component which confers upon wood its coherance, its strength and its anisotropy and therefore forms the basis of this study.

The long molecular chains of cellulose in all cell walls, including those of wood, are aggregated together and over some part at least of their length lie strictly parallel to each other and regularly spaced a uniform distance apart. This regularity in the arrangement makes it possible to study the structure of cellulose in wood by means of X-ray diffraction analysis and in more recent

years with the electron microscope. Electron microscopy identifies the long molecular chains of cellulose with the *microfibrils*, appearing as long flattened ribbons in the cell wall. These microfibrils are wider than the crystalites of cellulose postulated by X-ray diffraction analysis and implies that they are not uniformly crystaline. It is around these microfibrils that the incrusting substances are deposited. From other methods of investigation it appears that the microfibrils are to be thought of as being composed of long molecular chains which contain glucose and also other sugar residues. Whether the different sugars are organised into separate chains or whether they occur on the same chains is not at the moment known. The sum total of evidence suggests that the internal architecture of the microfibrils is such that each microfibril consists of a central core in which the molecular chains lie parallel to each other and regularly spaced in a crystalline lattice. Surrounding this is a cortex in which the chains, possibly owing to an admixture with chains of non-glucose sugars, are not so well packed and therefore do not form a regular crystalline array. Along the length of the microfibril the central crystalline core is probably interrupted by non-crystalline (or paracrystalline) material.

The Fine Structure of Conifer Wood

As is well known, the structural elements of conifer wood consist mostly of one type of cell only, apart from the ray parenchyma. These are the tracheids, long narrow cells several hundred times longer than broad, with thick cell walls and a wide lumen. Extensive investigations have made it clear that within each of the three layers of the secondary wall the structures which are now called microfibrils lie at an angle to tracheid length, forming a series of helices around the tracheid.

The Porosity of Wood

From the point of view both of movement of materials through wood in the living tree and of the movement of liquids, including preservatives, through felled timber it is important to take account of the sizes of capillary meshworks available for movement. It is clear that wood is markedly heterogeneous as regards capillary size. In conifer wood the largest available capillaries are the cell lumina which are normally about 10 microns in radius. These capillaries are permanent, and in the direction of the grain range from a millimetre or so in length up to a few centimetres. With angiosperm wood the vessels provide longitudenal capillary paths which are considerably wider, ranging in radius from about 15 microns up to 0.1 mm. or even wider. These capillaries are much longer, ranging from one to a few feet in diffuse porous woods up to the whole length of the trunk in ring-porous woods.

Each cell wall is permeated by a series of tortuous pathways which may be thought of as capillaries, which are estimated, from electron micrographs of dry wood, to be in the order of 50°_{A} up to $1{,}000^{\circ}_{A}$ in radius. These capillaries run through the thickness of the walls of each pair of contiguous cells and therefore have lengths at least equal to the thickness of a double cell wall.

The fact that the tracheids are long and narrow means that for longitudenal transport fewer cell walls have to be crossed per centimetre path length than for transverse transport and it is clear that the longitudenal transport is easier than transverse transport. In addition to the wall capillaries in the position of the bordered pit two contiguous tracheids are separated not by two secondary walls but by the two primary walls which together comprise the pit membrane; this membrane is not more than 2 microns thick and is traversed with pores very much larger than those effective in the body of the secondary cell wall. From electron micrographs it is estimated that the largest pores in the pit membrane are about $12{,}500A^{0}$ in diameter.

When liquid preservatives are passed through timber it is clear that some of the preservatives must pass through the pit membranes and to this extent closure of the pit membranes may to some extent reduce the rate of penetration. It seems likely, however, that by far the greater volume of liquid will pass through the much more numerous capillary systems in the wall and that the pit membrane (and therefore pit closure) is of minimum importance.

Microscopic Examination of Impregnated Wood

Microscopical examination of transverse sections of timber, treated with copper preservative (Tanalith C), shows quite clearly that the copper is distributed throughout the whole cell wall, although the distribution is patchy from place to place in a section. The stain is deepest in the middle lamella region, but the whole wall is nevertheless sufficiently well stained to show that a great deal of the copper is located within the cell walls. The only position in the wood in which a blue stain is not evident is on the inner face of the wall lining the cavity. This simple observation alone shows that the preservative is situated within and not upon the cell walls of the constituent cells.

From various methods of investigation the evidence so far indicates that the preservative is located within the cell walls and occurs in two forms (a) in the form of granular deposits as observed in the electron microscope and (b) in the form of more generally spread material adsorbed on the microfibrils. Electron diffraction analysis confirms that a considerable amount of the copper taken up into wood is taken up into wood is taken up by an adsorbtion phenomenon at a surface in this case the surface of the cellulose microfibrils.

Discussions and conclusions

All the methods adopted agree in showing that the preservative in impregnated wood is located within the

cell wall and intimately associated with the structural components. It follows that the flow path of the impregnating liquid during impregnation must lie through the cell walls as a whole and that the impregnating materials reach the structural elements through the transient capillaries of small dimensions which are ubiquitous in the walls.

Adsorbtion curves presented by electron analysis suggests that copper complexes with surfaces internal to cell walls and these surfaces can hardly be other than the surfaces of the microfibrils. In effect it appears that a large part of the copper in these copper preservatives is so disposed as to clothe many at least of the cellulose microfibrils with monomolecular layers of copper ions so that in a sense the cellulose is protected by copper plating. The more probable sites for adsorbtion of the metal ions are the hydroxyl groups.

The precise arrangement of the copper ions envisaged implies of necessity a high degree of order in the surface of the micro fibrils. It implies moreover that these surfaces are in a sense real surfaces and are not masked by adsorbtion upon them of lignin or other incrusting substances since precisely the same phenomena may be observed with whole wood as with purified wood cellulose.

(*To be continued*)

THE BIOLOGICAL ASSAY OF INSECTICIDAL AEROSOLS

(Lecture in three parts originally delivered to the Institute of Packaging on 8th April, 1959.

PART I

By F. G. S. WHITFIELD, D.I.C., M.I.Biol.

IT is not my intention to deliver a lengthy and detailed lecture on this subject, but rather to restrict myself to an outline of some of the problems involved in the bio-essay of insecticidal aerosols, the defects of the only existing so-called standard method and our reason for preferring the " Cooper " technique as published by Goodwin-Bailey, Holborn and Davies.*

During the past three or four years we have had an increasing number of requests to carry out bio-assay of insecticidal aerosols, which, until recently, we have had to refuse as we had not decided on a suitable chamber, nor were we at all happy about the only published " standard " technique for such a test, namely, the C.S.M.A. Aerosol Test Method.

The fundamental problem imposed by the pressure pack aerosol is that of dosage, inherent in the limitations of any existing valve, and the prime factor dominating the design of a suitable chamber is the ratio of dosage to cubic capacity.

It is precisely this problem with which the C.M.S.A. technique fails to deal. If we consider the C.S.M.A. Test Method for flying insects we see that the " test chamber shall be a Peet Grady chamber as specified in the Peet Grady Method or a larger chamber meeting the general specifications of the Peet Grady Chamber."

Now the Peet Grady Test Technique fails, in our opinion, on two counts:

1. The design of the chamber.
2. The design of the test.

If we consider the former we must realise that the aerosol test method is in essence an adaptation of the standard Peet Grady Test for space sprays and at once we find that the standard Peet Grady chamber of only 216 cubic ft. is too small to enable an accurate dose to be obtained from certainly most of the valves in present use. I will revert to this point in a moment. The C.S.M.A. scientists have clearly realised this as they have allowed a " larger chamber meeting the general specification of the Peet Grady Chamber."

However, the essence of the Peet Grady Test is that observation shall be carried out by personnel outside the chamber making their observations through the windows and here lies the first problem. If the chamber is enlarged to the point where a suitable and accurate dose can be obtained from a pressure valve then the chamber is too large for external observation. This means that the chamber must be large enough not only to allow of accurate dosage but to enable two persons to operate inside the chamber; from both these aspects the general opinion both of ourselves and of our colleagues at the Cooper Technical Bureau, is that the minimum size should be 1,000 cubic ft.

If we have a chamber of this size the actual design of the Peet Grady Chamber is no longer appropriate as windows are not required and in many places it would be too large to house inside a special room which, in turn, unless in a specially air-conditioned building, would be costly and difficult to insulate and maintain the required level of temperature and humidity—temperature gradients presenting a special problem. A chamber of this size should be designed as a separate and self-contained entity giving greater freedom of siteing and location.

Turning now to the design of the Peet Grady test I would make the following points:

1. An *additional test** must be carried out using O.T.I. to check that the 24 hours mortality is between 30 and 55% and with approximately 95% knockdown at 10 minutes. This seems needlessly to reduce the " efficiency " if the test method.

**Ann. App. Biol.* 1957, 45, No. 2. pp. 347-360.

**Soap and Sanitary Chemical*, 1958, Blue Book pp.227-228, 255-256.

2. The Peet Grady chamber has a volume of 216 cu. ft. i.e. about 1/5th of the 1,200 cu. ft. chamber used if the Cooper Method. The relative doses are 0.648 gm. and 3.0 gm. respectively, with tolerance ±0.108 gm. and 0.5 gm. With the former it seems that difficulty will be experienced in keeping within the tolerances which, although expressed as a percentage (±17% of the dose) seem extremely wide are in actual fact very small. Also there is the objection to the smaller dose that the abnormal opening and closing phases of the valve occupy an appreciable fraction of the total spraying period. It seems that 1,000-2,000 cu. ft. would be the optimum volume range of a test chamber.

3. The C.S.M.A. Test Method tends to sacrifice flexibility by rigid standardisation of every conceivable factor which may affect the response level, for the time being, of the flies. This is probably not adequate in many cases and, with a different experimental design, would not be necessary.

4. The experimenter is unable, and is in fact expressly forbidden, to extract more than a small fraction of the information from a test which if differently designed could afford a number of validity checks and a numerical estimate of the relactive potency of the test preparation with respect to the standard, *without any extra cost*.

5. There is no estimate of the " slope " (i.e. the increase in response produced by a tenfold increase in dose). If a zero or negative slope occurred the experimenter would not be aware of it, and would automatically give a wrong opinion on the quality of the test preparation.

6. There is no estimate of the precision of the result, and thus no basis for judging whether any observed differences in response level are significant or could have arisen by the ordinary random errors of sampling.

In view of these defects in the design both of the Peet Grady Chamber and test we decided to build a chamber to our design and in this we were greatly helped by the pioneer work done by Goodwin-Bailey and his colleagues, and this, I think is an appropriate moment in which to express our gratitude and appreciation for the help and advice they have extended to us throughout our trials.

The publication of their paper presented us with a focal point on which to build and although it is possible that the design of the test may—in the light of experience, be modified or improved, the Cooper technique was so essentially in accord with our own views that it seemed the obvious groundwork on which to have what we hope will become a British Standard Method and possibly an International Method. Our chamber was completed about ten months ago and the subsequent period has been spent in calibrating it, eliminating various teething troubles such as temperature gradient, proper use of mixing and exhaust fans, etc., and, these done, in carrying out a series of inter-laboratory tests with Messrs. Goodwin-Bailey and colleagues using the Cooper Technique.

I will now ask Mr. Goodwin-Bailey to take over.

PART II

By K. F. GOODWIN-BAILEY, D.I.C.

Although most people who are interested will have read the paper referred to by Mr. Whitfield and which appeared in the *Annals of Applied Biology*, for the benefit of those who have not it may be helpful to describe briefly the method to assess the biological efficiency of aerosols.

It was towards the end of the last war when the armed forces of the United States were given aerosols " bombs " to kill flies and mosquitoes. The " bomb " was a refillable metal container fitted with a nozzle and contained an insecticidal solution under pressure of about 80 p.s.i. It was early in 1949 when the Cooper Technical Bureau began experimental work with pressure aerosols and a test method to evaluate the biological efficiency of aerosols was needed. Methods for testing flysprays were not adaptable for the purpose and although there were methods for testing aerosols described by workers in the U.S. they were not considered entirely satisfactory. A test method should be related as far as possible to practical conditions. It is considered that the Cooper technique meets this point and is a check on performance of the complete product, i.e. insecticidal contents and valve.

At the Cooper Technical Bureau a large room is used, approximately 1,200 cu. ft. capacity, in which the temperature and humidity of the air is closely controlled and tests are usually carried out at approximately 80°F. and 50% R.H. The room is illuminated to give a mean light intensity of 10 fc. when measured 3 ft. above floor. The floor is covered with absorbent paper and this is removed after each test, the floor being the part of the room which becomes quickly contaminated. Walls and ceiling are checked for insecticidal residues at intervals of time and at any sign of insecticidal activity they are washed.

Having conditioned the room, 3 g. total aerosol filling per 1,000 cu. ft. are released and immediately afterwards 500 flies are liberated. Two operators are in the room and over a period of 10 minutes following release of

aerosol they record the number of flies knocked down at 2, 4, 6, 8 and 10 minutes. The flies are then collected by gentle suction into holding jars and mortality counts recorded at the end of 24 hours.

Early experiments were carried out with free flying flies and caged flies. From the experimental point of view caged flies have certain advantages, contamination of the floor covering is largely immaterial and complete control over the period of exposure is possible. The difficulty sometimes experienced in collecting active flies, still up at the end of the exposure period, does not arise. On the other hand it was found that cages limit the flight movement and cause screening of the aerosol which is important when considering the flight-stimulating property of some insecticides. It is also difficult to make accurate and frequent knock-down counts of flies in cages suspended at different heights. The cages are difficult to cleanse, but the most serious criticism is the failure to obtain good replication of results and this last point led to the adoption of free flying flies for the technique.

The technique is regarded as being entirely suitable for the needs of Industry. It can be used for the development of new formulations and types of dispensers and for routine testing of commercial products. In a performance test with commercial products it is suggested that the time taken to knock-down 50% should be established and that 100% mortality of flies should be obtained when the aerosol is discharged according to the makers' recommendations.

Mr. Whitfield's laboratories have been working on the technique and Mr. Whitney will be able to give some information concerning these tests.

PART III

By G. F. H. WHITNEY, B.Sc., A.R.I.C.

Goodwin-Bailey, Holborn and Davies have compared two preparations (numbered I and II) several times finding II less potent than I on all occasions. We have carried out 5 series of tests keeping as closely as possible to the conditions laid down for the Cooper method.

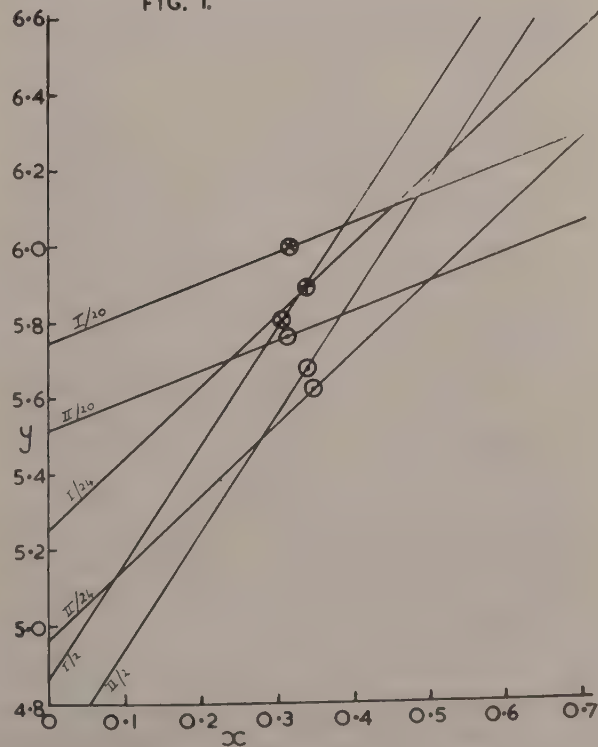
There were some differences such as the details of our test chamber which was just over 1,000 cu. ft. (theirs was almost 1,200 cu. ft.). The heating and ventilating arrangements were different and the intensity of illumination was higher (28 f.c. against 10 f.c.). The personnel were different and there were doubtless many other minor differences that we do not know about.

The results were closely comparable with those of the Cooper laboratories the absolute level of fly response being a little higher in our tests. In all five series the trials confirmed the Cooper results in placing preparation II at a lower level of potency than preparation I.

We felt, however, that further investigation might show the practicability of increasing the scope of the original test, not by modifying the technique, which we consider quite satisfactory, but by extending the usefulness to include a quantitative estimation of the relative potency of two preparations if the experimenter so wished. No additional testing was expected to be necessary but naturally a little arithmetic would be required.

On 20th March, a series of tests was started with a factorial design involving the two preparations at two dose levels with knock-downs recorded at 2, 4, 6, and 10 minutes and two replications of each treatment combination. The same arrangement was repeated on the 24th March and 2nd April. The relative potency of preparation II with respect to preparation I (which was taken as 100%) was calculated using two types of response namely the regression of the mean probit on log dose (" y/x ") and the regression of the log of the KD50 time on log dose. (" z/x ")

FIG. I.



It was found in brief, that:,

1. The slope of the regression varied appreciably from one occasion to another. Consequently the precision varied too (Fig. 1).

2. The two methods of calculation gave very nearly the same relative potency when derived from the same set of data (Fig. 2).

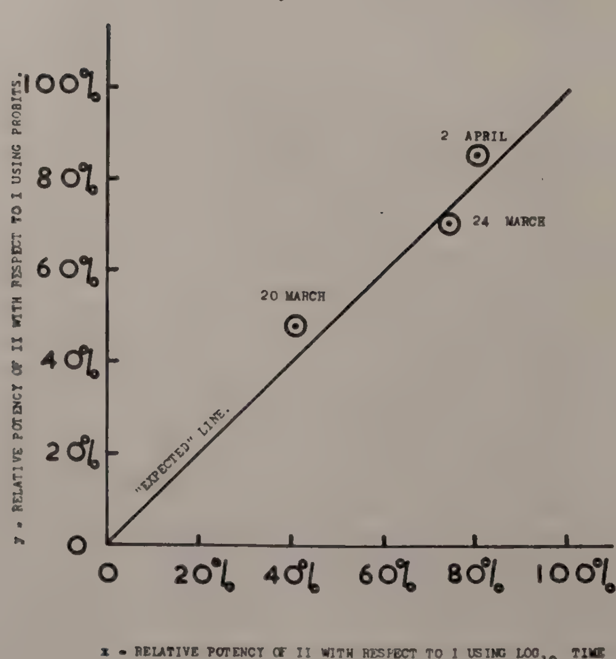
3. The efficiency of the methods of calculation as estimated by the quantity $\frac{s^2}{Nb^2}$ seem to be about the same. However, the possibility of one being slightly better than the other is not excluded (Fig. 3).

In the expression $\frac{s^2}{Nb^2}$, " s^2 is the variance of responses at fixed dose, N is the total number of subjects (flies) and b is the rate of increase in mean response per unit increase in log. dose. If values of N for the alternatives are chosen to represent experiments of equal cost, that for which $\frac{s^2}{Nb^2}$ is least will be the most economic."

(D. J. Finney, 1955. "*Experimental Design and its Statistical Basis*, p.140. Cambridge Univ. Press, London).

Since the alternative responses are in the present instance derived from the same experimental data N is taken to be the same for both.

FIG. 2.



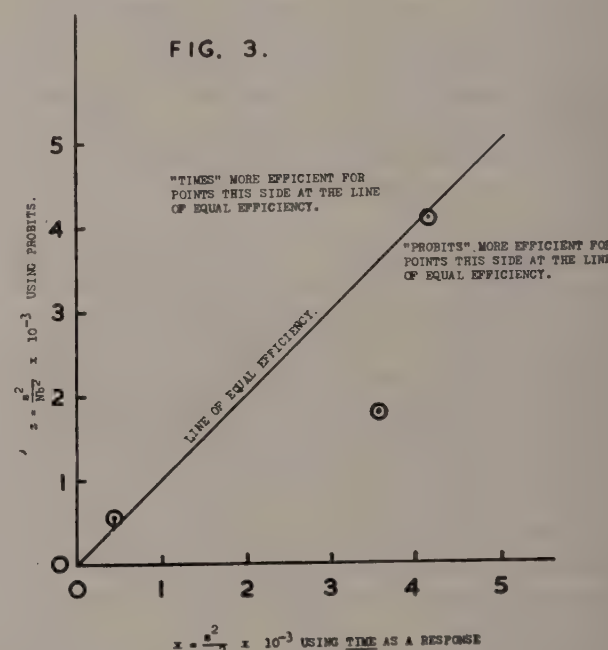
4. Correction of the results for aberrance of the sex ratios (on 20th and 24th March) by the equation:

$$32 + 0.36x = \text{"} 50_c \text{"}$$

(where x = % of male flies) appeared to have a tendency to decrease the slope of the z:x line slightly but its effect was not very marked.

5. The regression of y on z was not quite linear but the deviations were according to a regular pattern and the lines satisfactorily fulfilled the conditions of similarity.

FIG. 3.



To sum up: If we wish to apply the Cooper technique to the quantitative assay of one preparation with respect to another we are demanding more of the test than the mere ranking of the preparations which was originally intended, but the indications, so far, are that this extension will be quite practicable.

It will doubtless be necessary to include at least two dose levels so as to obtain an estimate of slope; to have a standard preparation on which to base the comparison and to derive from the data some estimate of the fiducial limits of error so as to ascertain the degree of precision attained.

Finally it, seems likely that the extra information will be obtainable without any appreciable increase in the amount of labour, and therefore the cost, involved.

The Detection and Estimation of Low Concentrations of Methyl Bromide in Air

By H. K. HESELTINE. (*Pest Infestation Laboratory, Department of Scientific and Industrial Research.*)

METHYL BROMIDE is widely used as a fumigant throughout the world. It is toxic to man and can give rise to acute or chronic symptoms according to the concentration level and length of exposure. The "safe" concentration for continuous exposure is, at present, taken to be 17 p.p.m.[1] It is obvious that methods of determining both high and low concentrations of methyl bromide in air are necessary to protect the health of those working with this material in factories or with fumigation companies.

Until recently the standard rapid method for the detection of low concentrations of methyl bromide in air was that using a halide leak detector lamp.[1] These lamps which are based on the Beilstein test in which a non-luminous flame becomes coloured green or blue in the presence of a halogen or an organic halogen compound are well known and need not be described here. When working properly they provide a very sensitive means of detection of concentrations of methyl bromide in air down to a few p.p.m. However, they have a number of serious disadvantages as shown below:

(i) They are not always easy to light. In the best circumstances this can take a few minutes so that a lamp is not always ready for immediate use. Also draughty conditions the flame may blow out. (These drawbacks are remedied to a certain extent by the recent introduction of a lamp using a small cylinder of butane as fuel.)

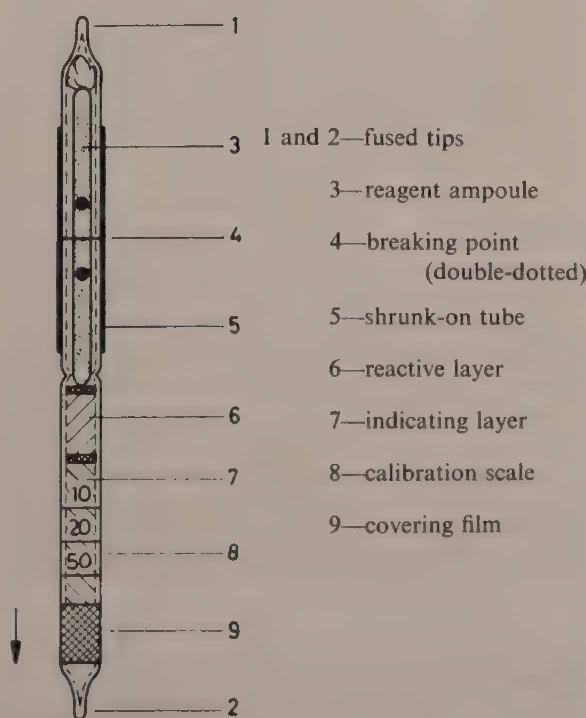


Fig. 1 Diagram of the methyl bromide detector tube.
(*Reproduced by courtesy of Drägerwerk of Lübeck*)

(ii) The lamps present a flame hazard and may not be used in certain warehouses and grain silos because of insurance or other regulations (e.g. Liverpool Corporation Act, 1921).

(iii) Different lamps vary a great deal in performance and the results given by one lamp vary from day to day.

(iv) Because of this variability of performance and since, in any case, it is difficult to memorise or match the colours of flames it is impossible to estimate even roughly the concentration of methyl bromide in air. The most that can be said is that the concentration appears to be very high or very low but a lamp cannot be used to give a rough quantitative indication in the "safe limit" range of the order of 20 p.p.m.

Because of these difficulties it has sometimes been necessary in the past to make chemical analyses of air samples.[2] These cannot give quick results, and require special skill so that although they may be used in specialist laboratories, they cannot be considered practicable for use in commercial fumigation practice.

A method has been devised[3] consisting of the catalytic decomposition of methyl bromide to bromine which reacts with a chemically impregnated paper so as to produce a stain. The length of the stain produced is directly proportional to the concentration of methyl bromide present. Unfortunately, the apparatus is not very simple and it has not yet become commercially available.

A few years ago German and American companies[4,5] marketed apparatus for the determination of low concentrations in air of certain gases and vapours. In both cases the method consisted of drawing air through an appropriate detector tube by means of a special sampling pump. The tubes contained reagents which produced coloured bands when exposed to the gases, the length of the band being proportional to the concentration of gas present. At that time tubes for methyl bromide detection were not made but early in 1959 Messrs. May & Baker drew attention to the introduction of tubes for this gas by the German Company and to their availability in the U.K.[4] This laboratory has now carried out a few tests with these tubes.

The apparatus used for the tests is shown in the figures. The detector tube (Fig. 1) is prepared by breaking off its tips and then opening the reagent ampoule by breaking the tube at the point shown. The special bellows pump is shown in Fig. 2 with the tube inserted into the inlet of the pump. The bellows is held with the tube vertically

Fig. 2 The bellows pump with detector tube in position
(Crown Copyright)

upright so that the contents of the broken ampoule rest above the reactive layer in the tube. This is ensured by gently tapping the sides of the tube. Five strokes of the bellows are required for the test which is completed in just over a minute. The makers state that the ampoule contains a powder impregnated with SO_3. This SO_3 on release is said to "activate" the reactive layer which consists of a mixture of potassium permanganate and fuming sulphuric acid on silica gel. This releases bromine from the methyl bromide drawn through the tube. The bromine then reacts with a reagent such as o-tolidine which is absorbed on the indicating layer. This layer is white before use but changes to a colour varying from greenish-yellow to brown during the test when methyl bromide is present.

The tests were performed in two ways. In the first set (A) concentrations were produced in a 1,700 litre steel fumigation chamber and samples were drawn into the detector tubes through a short piece of wide bore glass tubing which caused no restriction to the air flow. In

the second set (B) the concentrations were produced in an 80,000 litre chamber which was entered by the person carrying out the tests. In both sets concentrations were checked by drawing samples into evacuated all-glass 1 litre flasks containing 1 ml. cyclohexylamine. Determinations were completed after carrying out a modified Kolthoff-Yutzy oxidation of the bromide.[6]

The results obtained are shown below. Up to 20 p.p.m. they are expressed to the nearest 5 p.p.m. and above this, to the nearest 10 p.p.m. This was considered to be the highest accuracy obtainable owing to the small length of the scale on the tube. These results show that as a rough test the method is consistent. The errors appear to be higher at the higher concentrations but it would appear that, on the whole, the results are accurate to the limits imposed by the accuracy of reading the result on the tube scale, i.e. $\pm$ 5 p.p.m. up to 20 p.p.m. and $\pm$ 10 p.p.m. between 20 and 50 p.p.m.

Determining the result of a test takes a little practice. In some tests a clear cut band is not obtained and a "tail" is produced. In this case, it was found that the most accurate results were obtained by assessing where the continuous band of colour finished, a long tail being ignored.

	Actual concentration present (p.p.m.)	*Results given by tube (p.p.m.)* 1st operator	*2nd operator*
Test A	8	10	10
		10	10
	19	20	20
		15	20
	35	30	50
		40	40
	61	50	50
		50	50
Test B	8	10	—
		10	—
	36	30	—
		30	—
	56	40	—
		40	—

It has not yet been possible to carry out tests on different batches of tubes, or on tubes stored for long periods, or to make tests under widely differing atmospheric conditions. (Test A was at 15°C. and B at 20°C.) The manufacturers state that the tubes ~~are stable~~ be stored for 2 years at temperatures ~~between 0° and 40°C.~~ not higher than 30°C., and that the actual test can be carried out at temperatures between 0° and 40°C. The tubes are not entirely specific for methyl bromide and will give a colour with some other halogenated hydrocarbons. This is not important in fumigation work.

It is usual for a tube once used to be discarded. However, a few tests on the following lines have been made. The process of preparing the tube and sampling was carried out once in fresh air after which a concentration was sampled with the same tube. The results obtained were identical with those using a fresh tube. This seems to indicate that, as a measure of economy, a fumigator can conserve his supply of tubes when searching for concentrations. If no methyl bromide is detected, a tube can possibly be used again within a short period, if only as a rough test for the presence of methyl bromide. The result can be confirmed, if necessary, by the use of a fresh tube.

In view of the success of these tests and the potentialities of this equipment in fumigation practice, the following suggestions are made.

(i) The halide detector lamp still has its uses in searching for leaks and as a very rough continuous guide to the concentration of methyl bromide in the atmosphere being tested.

(ii) The detector tubes provide a more accurate means for deciding whether buildings are safe to enter after a fumigation and for determining concentrations whenever there is the possibility of a toxic hazard to man.

(iii) If the detector tubes show a concentration greater than 50 p.p.m. it may be possible to use a thermal conductivity meter.[7] With a meter of this type a concentration of the order of 50 p.p.m. can, with care, be detected and readings above this level can be made with an accuracy of about $\pm$ 25 p.p.m. By the use of these last two methods it is thus possible for a fumigator to check concentrations from the high levels found during a fumigation down to levels below the "safe limit."

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[3]Call, F., 1952. *J. Sci. Fd. Agric.*, 3, 463.

[4]*Dragerwerk of Lubeck* (U.K. agents: Normalair Ltd., Manchester).

[5]Mines Safety Appliances Company Ltd., Pittsburg (and in U.K., Glasgow).

[6]*Pest Infestation Research*, 1948, p. 21. H.M.Stationery Office.

[7]Heseltine, H. K. ,Pearson, J. D. and Wainman, H., 1958. *Chem. and Ind.*, 1287.

NOTE

* *These tubes with different reagents are widely used in various industries for the detection of small quantities of gas in air. A large range of gases can be detected and one of the latest inovations is a tube for the detection of the insecticide "systox" in air.*

NEWS — Farm Services

The Ministry of Agriculture, Fisheries and Food have ceased to service farms for the control of rats. The I.P.C.A. have therefore issued a list of members with available services.

Insecta Laboratories Ltd.,
15 Paradise Street, Liverpool, 1.
Tel. No. Royal 1668.

Ratsouris Ltd.,
26 Victoria Street, Manchester, 3.
Tel. No. Stepping Hill 5030.
(*Cheshire*)

Ratsouris Ltd.,
104 West Broadway,
Westbury on Trym, Bristol.
Tel. No. Bristol 625275.
(*Hereford*)
Ratsouris Ltd.,
112 Hamstead Road,
Birmingham, 20.
Tel. No. Northern 0976.
(*Shropshire*, *Staffs.*, *Warwicks.*, *Worestershire*)
Scientex Ltd.,
Neptune House,
309 Corporation Rd., Birkenhead.
Tel. No. Birkenhead 730.
Scientex Ltd.,
119 Dale End, Birmingham, 4.
Tel. No. Birmingham Central 1827.

Eastern Region* (*Bedfordshire*, *Cambridgeshire*, *Essex*, *Hertfordshire*, *Hunts. and Soke of Peterborough*, *Isle of Ely*, *Lincs.* (*Holland*), *Norfolk*, *Suffolk*).

British Insecticides Ltd.,
11/13 Moscow Road,
Bayswater, London, W.2.
Tel. No. Bayswater 0033.
(*Essex*, *Herts.*)
Disinfestation Ltd.,
Station Place, Letchworth, Herts.
Tel. No. Letchworth 576.
(*Bedford*, *Hunts.*)
Disinfestation Ltd.,
Pylon Works, Hertford Road,
Barking, Essex.
Tel. No. Rippleway 4851.
(*Essex*, *Suffolk*)
Disinfestation Ltd.,
Conway Chambers,
83 Derby Road, Nottingham.
Tel. No. Notts. 44833.
(*Lincs.*)
Disinfestation Ltd.,
The White Building,
Fitzalan Square, Sheffield, 1.
Tel. No. Sheffield 23555.
(*Lincs.*)

Disinfestation Ltd.,
109 King Street,
Norwich, Norfolk.
Tel. No. Norwich 27583.
(*Norfolk*, *Suffolk*)
W. Edmonds & Co. Ltd.,
Ratbane House,
59 Pembridge Road, London, W.1.
Tel. No. Park 3124.
Insecta Laboratories Ltd.,
70A Hamstead Road,
Birmingham 19.,
Tel. No. Northern 4036.
Insecta Laboratories Ltd.,
8 Churchton Street,
London, S.W.1.
Tel. No. Victoria 3294.
Ratsouris Ltd.,
Walden House, Houghton, Hunts.
Tel. No. St. Ives (Hunts.) 3004.
(*Bedford*, *Cambridge*, *Hunts.*, *Lincs.*)
Ratsouris Ltd.,
Hollies Farm, Moor Road, Sutton,
Stalham, Norfolk.
Tel. No. Stalham 494.
(*Norfolk*)
Ratsouris Ltd.,
50 Central Street, London, E.C.1.
Tel. No. Clerkenwell 3816/7.
(*Essex*, *Herts.*, *Norfolk*, *Suffolk*)
Scientex (Southern) Ltd.,
30/31 Queen Street, London, E.C.4
Tel. No. City 1151.
South Beds. Pest Control,
59 High Street, Meppershall, Beds.
(Messrs. Woodbine and Taylor)
Tel. No. Shefifford 465.
(*Bedford*, *Cambridge*, *Herts.*, *Hunts.*)

South - Eastern Region* (*Berkshire*, *Buckinghamshire*, *Hampshire*, *Kent*, *Middlesex*, *Oxfordshire*, *Surrey*, *Sussex*).

British Insecticides Ltd.,
11/13 Moscow Road,
Bayswater, London, W.2.
Tel. No. Bayswater 0033.
Disinfestation Ltd.,
15/17 Westover Road,
Bournemouth, Hants.
Tel. No. Bournemouth 1620.
(*Hampshire*)
Disinfestation Ltd.,
144 Camden High Street,
London, N.W.1.
Tel. No. Gulliver 7071.
(*Middlesex*, *Kent*, *Surrey*, *Sussex*)
Disinfestation Ltd.,
1 Friar Street,
Reading, Berkshire.
Tel. No. Reading 54928.
(*Berks.*, *Bucks.*, *Oxford*)

W. Edmonds & Co. Ltd.,
Ratbane House,
59 Pembridge Road,
London, W.11.
Tel. No. Park 3124/5.
P. W. Finch, (Allpest Control) Ltd.,
5A and 6 Bridge Street,
Godalming, Surrey.
Tel. No. Godalming 2392/3.
(*Surrey*)
Insecta Laboratories Ltd.,
70A Hamstead Road,
Birmingham, 19.
Tel. No. Northern 4036.
Insecta Laboratories Ltd.,
20 Havelock Road, Southampton.
Tel. No. Southampton 24325.
Insecta Laboratories Ltd.,
8 Churdhton Street,
London, S.W.1.
Tel. No. Victoria 3294.
Ratsouris Ltd.,
50 Central Street, London, E.C.1.
Tel. No. Clerkenwell 3216/7.
(*Berks.*, *Bucks.*, *Kent*, *Oxon.*, *Surrey*, *Sussex*)
Ratsouris Ltd.,
70 Archers Road,
Eastleigh, Hants.
(*Hampshire*)
Scientex (Southern) Ltd.,
30/31 Queens Street,
London, E.C.4.
Tel. No. City 1151.
South Beds. Pest Control,
59 High Street,
Meppershall, Beds.
Tel. No. Shefford 465.
(*Bucks.*)
H. Tiffin & Son Ltd.,
37 George Street, London, W.1.
Tel. No. Wellbeck 3986.

South - Western Region* (*Cornwall*, *Devon*, *Dorset*, *Gloucestershire*, *Somerset*, *Wiltshire*).

Disinfestation Ltd.,
25 Sidwell Street, Exeter, Devon.
Tel. No. Exeter 56531.
(*Cornwall*, *Devon*)
Disinfestation Ltd.,
15/17 Westover Road,
Bournemouth, Hants.
Tel. No. Bournemouth 1620.
(*Dorset*, *Wiltshire*).
Disinfestation Ltd.,
54 Baldwin Street, Bristol, 1.
Tel. No. Bristol 23683.
(*Gloucester*, *Somerset*)
Insecta Laboratories Ltd.,
174 Whiteladies Road, Bristol, 8.
Tel. No. Bristol 36428.

to be continued.

NEWS

National Farm Management and Work Study Conference

Farmers from all over the country attended a National Farm Management and Work Study Conference at Oaken, near Wolverhampton, on Thursday, 2nd July.

The Conference—which was arranged by the Staffordshire Agricultural Productivity Committee, with the support of the Ministry of Agriculture, Imperial Chemical Industries Ltd., and the National Farmers' Union—took place on the Bradshaws, Oaken, a 400 acre farm tenanted by Mr. Peter Smith.

The object of the Conference, which was under the chairmanship of Professor H. G. Sanders, Chief Scientific Adviser, Ministry of Agriculture, was to give farmers an opportunity to see and hear about practical examples of work study on the farm.

Eight years ago the Bradshaws was carrying 15 enterprises with a gross output of about £34,000.

Today, as a result of work study the fifteen enterprises have been streamlines into five, estimated potential output has been stepped up to £60,000, and capital equipment reduced by one-third.

The five enterprises that have been work-studied by the I.C.I. Agricultural Work Study Unit are pigs, wheat, turkeys, blackcurrants and the production of beef from grass.

Speakers at the Conference included Mr. Arthur Jones, Chief Farm Management Advisory Officer, N.A.A.S., and Head of the Work Study Unit; Mr. Gordon Lugg, Head of the I.C.I. Agricultural Work Study Unit; Mr. H. Collison, General Secretary of the National Union of Agricultural Workers, and Mr. J. Rhys Thomas, Vice-President of the N.F.U.

In his address Mr. Gordon Lugg gave a summary of various work studies carried out at Bradshaws including an investigation into the spraying of soft fruit (blackcurrants). The aims of the investigation were:

i. Improving the efficiency of utilisation of labour and equipment.

ii. Reducing the overall time of the operation so that a larger acreage of fruit can be sprayed in a given time. This is important as it is vital that advantage be taken of favourable weather conditions.

Note: Study of the merits of the various spraying techniques, e.g. high versus low volume spraying, etc., was considered as being outside the scope of this investigation.

Proposals

1. 16.3% of the total time was spent travelling from the work point to the steading and back, for water. Three conveniently situated static water storage tanks, supplied by the existing mains with ball cock adjustments would practically eliminate this wasted time. These tanks should be 8 ft. from the ground so that the sprayer can be backed in below them; they should hold 250-300 gallons, and the mains supply must be good enough to maintain a supply of water in the tank during a day's spraying. There should be a large outlet pipe to allow quick filling of the sprayer.

2. 12.7% of the total time was spent turning on the headland to get into the next row. This time would be greatly reduced if the tractor turned into alternate rows working across the field one way, and ran up the missed ones on the way back. With small bushes where the booms could completely cover them, the run back need not be done.

Summary

The overall job time has been reduced by 23% by:

i. Installing three static water storage tanks in strategic places around the orchards, and

ii. Modifying the sprayers routine while actually working.

Sir Alexander Fleck is to resign as chairman of Imperial Chemical Industries in February, 1960. Sir Alexander, who will be 70 in November, is also retiring as a director of the company with which he has been associated for more than 44 years.

His successor will be Stanley Paul Chambers, a deputy chairman.

Pest Advisory Centre

Another new Woodworm, Dry Rot, and Pest Advisory Centre—the tenth—was opened at 55, Mansfield Road, Nottingham, on Tuesday, 2nd June. Two official openings were held, one at lunchtime and one in the evening.

The local press took a great interest in the event, and a photograph of the regional manager, Mr. C. H. Smith, holding a piece of decayed church timber, appeared on the front page of the Nottingham Evening News.

Dr. Norman Hicken told guests that nearly 80% of the 13½ million homes in the country were infested to some extent with either woodworm or wood rot.

Another new Centre is to be opened by the British Ratin Group in Newcastle on 9th July. These Centres contain permanent exhibitions with displays, pictures, and specimens concerning woodworm, wood rot, insect pests, rodents, and weeds.

New Cyanamid Appointment

Mr. Charles F. Bonnet has been appointed associate director for the European Region of Cyanamid International at the company's European headquarters in Zurich, Mr. Bonnet has been associated with Cyanamid for 25 years.

Mr. S.C. Moody, Director General of Cyanamid International, in making the announcement, said:

"In view of the increasing scope of our activities in Europe, we have found it advisable to expand our management staff in Zurich. We are confident that Mr. Bonnet's long experience in the chemical side of our business will prove of benefit to the company's clients in the European area."

Mr. Bonnet has, for the past three years been manager of Cynamid's Fortier plant near New Orleans, Louisiana, a $100 million installation which produces sulphuric acid and other heavy chemicals.

The agenda of the Labour Party for the 58th Annual Conference, to be held at Blackpool 5th October—9th October, contains a resolution from Aldershop Labour Party instructing the National Executive Committee "to appoint a committee to examine ways and means of compensating owners of crops damaged by poisionous sprays, and at the same time possible safer methods of spray application."

NEWS

Non Cartridge Type Demineralised Water Units

Water demineralising, or de-ionising, units are now superseding the still and distilled water delivered in carboys as a source of supply of purified water for laboratories and similar establishments. A feature of many such units, however, is their reliance on detachable cartridges of ion exchange resins which are returned to the supplier when exhausted.

The Mark 4 and Mark 5 Portable "Deminro lit" Plants manufactured by The Permutit Co. Ltd., have been designed for "easy on the spot" regeneration of the exhausted ion exchange material, thus obviating the need for detachable cartridges and replacements. Since regeneration requires only very small amounts of inexpensive chemicals running costs are reduced to less than a half-penny per gallon of demineralised water produced.

Both plants consist of a pair of sealed columns charged respectively with "Zeo-Karb" cation and "De-Acidite" anion exchange resins, the water being passed through the columns in that order. Flexible connection and delivery tubes, with a multi-valve control system, facilitate operation and regeneration. A built in dial type conductivity tester enables "spot" checks to be made on the quality of water being produced. By this means the point at which regeneration becomes due may be determined precisely.

Regeneration involves flushing the cation column with a dilute solution of hydrochloric acid and the anion column with dilute caustic soda or soda ash solution. Both columns are then rinsed with water when the plant is ready for further use.

Either plant is available as Type 'E' or Type 'F,' the difference being in the type of resin used in the "De-Acidite" column. The former produces a demineralised water comparable to commercial distillate while the latter produces a much higher quality.

Output between regenerations will depend on the raw water quality—that from the Type 'F' plants being somewhat less than that obtained

Permutit Mark 4 Portable "Deminrolit" Plant.

from Type 'E.' Using London Area (M.W.B.) mains water the output from a Mark 5 'E' Plant will be approximately 50 gallons while the same plant using Manchester water will produce about 300 gallons.

Flow rates are unaffected by the Type of plant or quality of the raw water; the Mark 4 produces demineralised water at about 11 gallons hourly—the Mark 5 about 6 gallons hourly.

The Mark 4 is mounted in an upright tubular framework on a small, rubber tyred, two wheeled undercarriage which enables easy transportation between departments. The smaller Mark 5 is equipped with a carrying handle and is designed for bench level operation.

Both plants are constructed throughout from non-corrodible materials and operate at normal cold water tap temperatures and pressures.

Wood-Pigeons: A new method of Control

The organised shooting of wood-pigeons over a number of years has not reduced their numbers sufficiently to prevent them from being a serious menace to crops and research has been going on by Ministry scientists to find supplementary control measures.

In a Parliamentary Reply today, the Minister of Agriculture, Fisheries and Food said that experiments over the past three years have shown that the number of wood-pigeons can be considerably reduced by the systematic destruction of their nests over wide areas at specified periods from July to September. To encourage the use of this method in an organised and humane manner, the Government has decided that the cost of nest destruction carried out by rabbit clearance societies, may qualify for the 50% grant. This should stimulate concerted action against both rabbits and wood-pigeons.

Nest destruction is not a substitute for shooting; for best results both methods should be used.

Further information, together with an explanatory leaflet, can be obtained from any divisional office of the Ministry of Agriculture, Fisheries and Food.

Cooper, McDougall and Robertson Limited

The Directors of Cooper, McDougall and Robertson Limited announced on 25th June that the period for acceptance of the unconditional offer by The Wellcome Foundation Limited to purchase all the Ordinary Shares of the Company has been extended up to 16th July, 1959. Acceptances have now been received in respect of over 92% of the Ordinary Shares.

It was later announced that Mr. G. F. Taylor, C.B.E., and Mr. T. Al Roberston have resigned as directors of the Company.

Mr. A. A. Gray, Mr. J. D. Robinson and Dr. Fred Wrigley have been appointed directors, and Dr. D. W. Adamson an alternate director.

The four new directors are also directors of The Wellcome Foundation Limited.

Lord Rochdale joins Board of Geigy (Holdings) Ltd.

Geigy (Holdings) Limited of Manchester have announced that the Rt. Hon. The Lord Rochdale, O.B.E., T.D., D.L., has accepted a seat on its Board.

Lord Rochdale is Chairman of Kelsall & Kemp Limited, wool textile manufacturers in Rochdale, also of its associated company in Tasmania, Chairman of the Cotton Board and a past President of the National Union of Manufacturers; he has recently completed his term of appointment as a member of the Board of Governors of the BBC.

NEWS

A.B.M.A.C. Committee 1959/60

The following Officers and Executive Committee will serve the Association during the year 1959/60:

Chairman, Mr. George Huckle, Shell Chemical Co. Ltd.; Vice-Chairman, Mr. H. C. Mellor, Plant Protection Ltd.; Hon. Treasurer, Mr. H. J. Jones, O.B.E.; Hon. Auditor, Mr. D. J. S. Hartt, May & Baker Ltd.

Executive Committee: Mr. A. W. Billitt, Boots Pure Drug Co. Ltd.; Dr. J. R. Booer, Lunevale Products Ltd.; Mr. E. T. Bugge, Bugges Insecticides Ltd.; Mr. C. L. Chafer, J. W. Chafer Ltd.; Mr. R. V. Craven, W. J. Craven & Co. Ltd.; Mr. J.F.H. Cronshey, Plant Protection Ltd.; Mr. M. N. Gladstone, Fisons Pest Control Ltd.; Mr. D. Nahum, Pan Britannica Industries Ltd.; Mr. J. Walker, A. H. Marks & Co. Ltd.

Hon. Vice-Chairman, Mr. H. J. Jones, O.B.E.,; Secretary Mr. W. A. Williams, M.B.E., B.Sc.

Success for the Micron Twin Concentrate Sprayer

In 1958 Micron Sprayers Ltd. introduced the Micron Twin, a machine developed largely for the spraying of hops but also suitable for top fruit, soft fruit, potatoes and other crops. This concentrate sprayer is a tractor powered unit embodying two of the renowned rotary atomisers developed by Micron Sprayers Ltd.—atomisers which provide extremely fine and even droplets carried on air beams. The Micron method provides economy in water and chemicals, as well as a saving in labour, and these factors are allied to complete and safe spraying because the concentrate dries immediately without scorch or drop-off.

At the end of 1958, its first full season in use, results achieved by the Micron Twin were examined. These show that, despite the poor season, excellent control of mildew on hops was obtained wherever the machine was used, while it proved equally effective for other crops. Not only were results outstandingly good but the speed of operation was high. For example, one contractor who sprayed an accumulated acreage of 800 acres of hops claimed that, dependent upon conditions, the Micron Twin enabled him to spray at rates varying between 30 and 50 acres a day.

Since the introduction of the Micron Twin, Micron Sprayers Ltd. have joined the Birfield Group of companies. Their offices and works are now located at 44, Bradford Street, Birmingham, 5. (Telephone—Birmingham Midland 0276).

Air Lift to the Rescue

Situation in the sugar beet fields due to infestation by millions of black and green flies is still one of crisis.

There appears to be no end in sight to the infestation.

The shortage of efficient insecticides to fight this plague could easily have been catastrophic. Up to now, however, over 300,000 acres of beet have been sprayed, many thousands twice or three times. The majority of this acreage was treated with Metasystox, an insecticide imported from Western Germany.

This was only possible because Baywood Chemicals, the importer of this product, organised the biggest air lift of any chemical product ever undertaken.

Some forty aircraft have flown in some hundreds of thousands of tins of insecticides which is the biggest freight load ever flown into London Airport by any importer in such a short time.

It is hoped that final consignments will once and for all turn the scale in sugar beet at any rate. It now appears, however, that exactly the same emergency may be arising in the brassica crops.

NEWS

New Weedkiller to be made in Britain

(East Anglian Plant for Anti-Couch Chemicals)

Big sales of an important new systemic, selective weedkiller, Dowpon, which is used against couch grass, perennial and annual grass weeds, reeds and bracken, have decided Dow Agrochemicals Ltd., who market it in Britain, to build a big plant to manufacture it in East Anglia, under license from the Dow Chemical Company of the U.S.A. Manufacture in Britain is expected to lead to lower prices.

The new factory is to cost £1 million and is to be built by Dow Agrochemicals Ltd. at King's Lynn, Norfolk, as the first stage of a project planned to become the largest agricultural chemical plant in Europe. Though Dowpon will be the first product, it is intended to build extensions of the factory and produce others of the Dow Chemical Company's specialised range there later.

Dowpon has become well-known to farmers and horticulturists recently because of its importance in meeting the serious menace of couch and other types of perennial and annual grass weeds to British foresters, arable and dairy farmers. Other chemical weedkillers have banished other weeds, but have proved ineffective against couch which has been kept inadequately and expensively in check by cultivation. Dowpon, offering a better substitute for these methods, is becoming important to farmers and growers in many areas, and Dow Agrochemicals is confident of its future.

King's Lynn was chosen as the manufacturing location, not only because it is in the heart of the grain farming counties, but also because it is nearer to the Dow Chemical Company's European ocean terminal, Rotterdam, than London, and the British firm expects to ship to all parts of the British Isles and to export Dowpon and other chemicals to Europe, Commonwealth Territories in Africa and other overseas destinations.

An industrial development certificate has been issued by the Board of Trade for a site of 66 acres on the right bank of the Great Ouse, with a river frontage of 5,000 feet. A railway and a pipeline from the Bentinck Dock will serve the factory. Lynn Council will provide roadways and accommodation for factory workers.

Civil engineering work on the site is to be put out to tender and the first phase of the factory is expected to be in operation by August 1960.

Dow Agrochemicals Ltd., as was announced last year, is a company formed by the Dow Chemical Company in Britain to manufacture and market agricultural chemicals in partnership with Dr. W. E. Ripper, the well-known expert on pest and weed control. Shares are held in the proportion of 74% by the parent company in the United States and the remainder by Dr. Ripper, who is the managing director of Dow Agrochemicals Ltd.

The Chipman Chemical Co. Ltd., which, since it first introduced chemical weedkilling methods to the British Railways in 1926, has been in the forefront of industrial chemical weed control, have supplied a new weedkiller spray train to British Railways, Western Region. This train is the fifth designed and built by the Chipman Chemical Co. Ltd., and the third since the war. At the present moment the weedkiller train distribution on the British Railways is:—

Southern Region	2
Midland Region	2
Western Region	2

all of which are owned by the regions concerned. The three Chipman trains run over the Eastern, North Eastern and Scottish Regions and this year part of the Western Region.

Pest Proof Packs

The Printing Packaging and Allied Trades Research Association announce in their research programme that: "Regarding mould and insect attack, research will be carried out on much the same lines as before, i.e. to continue the development of methods for the quantitative estimation of mould infection, to study the behaviour and nutritional requirements of fungi isolated from packaging materials, to examine the efficiency and suitability of fungicides and insecticides and to collect information about the toxicity of these repellants with a view to ascertaining to what extent such materials barred in foodstuffs may be permitted in packaging materials and under what conditions.

Atoms v. Pests

When delivering his address, "The Future Prospects in the Atomic Energy Field," at the opening of the Tehran Nuclear Centre, Sir John Cockroft, O.M., F.R.S. said, "In the field of agriculture research the staff of the Nuclear Centre have begun experiments to study the migration of the soum fly pest by releasing insects sprayed with radio-active tracers.

"The U.S. biologists were able to eliminate the screw-worm fly pest from Curacao by sterilizing male flies with large doses of radiation and then releasing them. They are now applying this method in Florida on a much larger scale. Entomologists are naturally looking round for other applications of this method which depend on the particular mating habits of the pests."

Sir John also mentioned that sources of radio-cobalt are being used for the sterilization of anthrax baccili in goat hair which is extensively employed in carpet manufacture.

In addition he said, "Another application is to the sterilization of surgical dressings, blankets used in hospitals, and kits of surgical instruments, particularly plastic hypodermic syringes. Sterilization by heat is not possible in these cases so that radiation provides an efficient alternative method.

"There are also possible future applications to the destruction of pests in large grain silos. The grain would travel on a conveyor belt past a massive radio-active source and the radiation would then kill the flies and sterilize the eggs."

New Main Board Appointments

The Board of Albright & Wilson Limited announce that Sir Owen Wansbrough-Jones will be appointed to a full-time directorship as from 1st October of this year.

Sir Owen Wansbrough-Jones, K.B.E., C.B., M.A., Ph.D., F.R.I.C., has held a number of senior scientific posts in the Civil Service culminating in his appointment in 1953 to be Chief Scientist of the Ministry of Supply. Before joining the Army in 1940 and the public service in 1946, he was for several years Tutor of Trinity Hall, Cambridge, of which college he was a Scholar and is now hon. Fellow.

FERTILIZER NEWS

The initial production of a healthy crop is of the utmost importance in the battle against agricultural pests.

A Large New Fertiliser Factory at Cork

W. and H. M. Goulding Limited, the well-known fertiliser manufacturers, have appointed Simon-Carves Ltd. as main contractors for the design and construction of the final development of their £2 million Marina Works at Cork, the first stage of which was completed in 1957.

The contract now placed with Simon-Carves substantially exceeds £1 million. The Marina Works development comprises a sulphur-burning contact-type sulphuric acid plant (the first in Eire) to produce 70,000 tons per annum of 100% sulphuric acid, plants to use the acid in the production of the equivalent of 200,000 tons per annum of superphosphates as single and triple superphosphates and compound fertilisers, etc., and the associated handling and storage equipment; this new output will be additional to Goulding's present production.

When completed in a year's time, the 18 acre Marina Works will be one of the biggest industrial undertakings in Eire and one of the most modern and economic fertiliser factories in the world. The production is planned to meet both present and anticipated future demand.

The Fertiliser Society

At the Twelfth Annual General Meeting of this Society held in Edinburgh on Thursday, 21st May, 1959, Mr. J. Frisken was elected President and Dr. H. L. Richardson, Vice-President.

Dr. G. W. Cooke, Mr. H. B. Hill and Mr. H. C. Kidd were elected to fill vacancies on Council.

Fertiliser Subsidy, 1959/60

The fertiliser subsidy arrangements continue almost unchanged for another year from 1st July under the Fertilisers (United Kingdom) Scheme 1959, which Parliament has just approved.

The rates of subsidy for phosphatic and for nitrogenous fertilisers are the same as for the 1958 Scheme except that the contribution for sulphate of ammonia is raised by 1/6d. to £9 19s. 6d. a ton because the guaranteed nitrogen content of supplies marketed for the British Sulphate of Ammonia Federation has been increased from 20.8 to 21.0%.

The only other change is that " Nitro-Chalk " is no longer scheduled by name, but comes under the heading " Other inorganic or synthetic fertilisers containing nitrogen (N) and/or etc.," at the appropriate rate of 9/6d. for each 1%, or part thereof, by weight of nitrogen. The contribution in respect of " Nitro-Chalk " (15.5% N) is, therefore, £7 7s. 3d.

New Fertilizer Organisation
Lowering of Fertilizer Prices

Following the opening in May of their large new Ammonia Plant at Shell Haven on the Thames Estuary, Shell Chemical Company Ltd., announce the following staff appointments which became effective at the beginning of July, 1959.

Mr. T. N. Reid, formerly Head of Fertiliser Sales has been given a special appointment in Agricultural Technical Department. Mr. H. J. A. Millachip, previously Head of the Fertiliser Section in Agricultural Technical Department, becomes Head of Fertilizer Sales.

Mr. Millachip has had considerable experience in the industry. Before joining Shell Chemical Co. in 1956, he spent seven years with the Colonial Government Service in the Kenya Department of Agriculture, and at the Grassland Research Station at Kitale, Kenya, where he undertook a wide range of trials with fertilizers. In the Company's Technical Department, Mr. Millachip has been responsible for the fertilizer development programme and has played an important part in the development work connected with the introduction of the nitrogenous fertilizer, " Nitra-Shell."

The new head of the Fertilizer Section in Technical Department is Mr. J. A. Clifford. From 1946-57, Mr. Clifford worked with the Ministry of Agriculture in Hampshire as N.A.A.S. adviser for the areas of Petersfield and Romsey and in the county's Technical Department at Winchester. Here he acted as an adviser on crop husbandry work, grassland management and the general use of fertilizers. He also organized local fertilizer demonstrations and lectured on grassland and chemical subjects to local farming clubs. Mr. Clifford has since been concerned with Shell Chemical Company's experimental work on "Nitra Shell" and is a member of the committee organising the National Grassland Demonstration to be held in June, 1960.

From 1st July, 1959, Shell Chemical Company Limited are reducing the prices of both " Nitra-Shell " 23 and Magnesium " Nitra-Shell " by 10/-d. per ton. The farmer's prices for 6 ton lots delivered to the nearest station will be £26 5s. 0d. per ton for " Nitra-Shell " 23 and £26 18s. 6d. for Magnesium " Nitra-Shell " Once the subsidy of £10 18s. 6d. per ton has been claimed on " Nitra-Shell " 23, the cost to the farmer will be £15 6s. 6d.

This announcement follows the recent opening of the Company's new fertilizer plant at Stanford-le-Hope, Essex. Production of " Nitra-Shell " from this Plant is expected to commence later this year but it is already clear that its capacity will be inadequate to satisfy the total demand for this product and some quantities will again be imported from the plant in Holland.

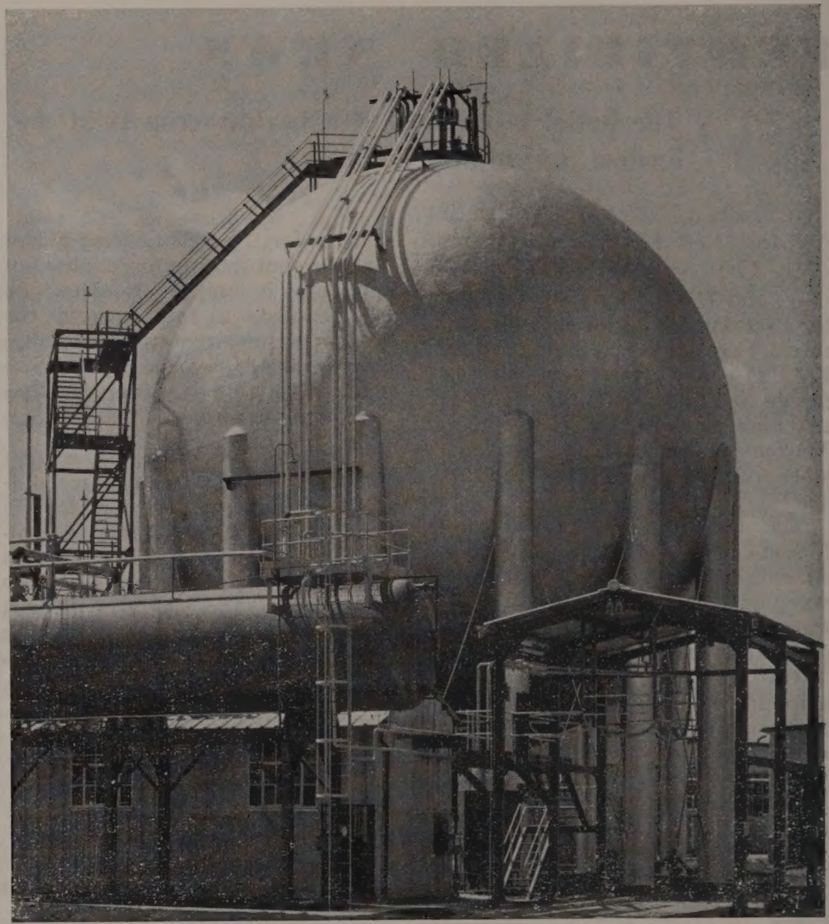
Both " Nitra-Shell " 23 and Magnesium " Nitra-Shell " will continue to be packed in the special 5-ply valve-type paper bags which enable these products to be stored for long periods. Supplies of both products will be available from the Company's appointed distributors on Early Storage Rebate terms.

Fisons Factory

Recently the trade and technical press has given well deserved publicity to the opening of Fisons new factory at Stanford-le-Hope, Essex. The factory was officially opened on 9th June by Lord Netherthorpe, President of the National Farmers' Union of England and Wales, and with its estimated production of 400 tons of Ammonium nitrate per day represents one of the most important advances in the fertilizer industry since the war.

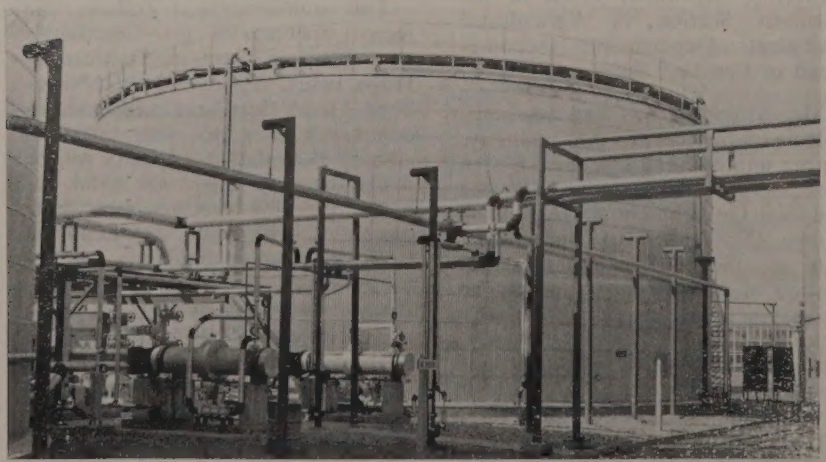
Ammonium nitrate which has superseded ammonium sulphate as the raw material used to provide nitrogen in compound fertilizers, has two major advantages. Firstly it provides nitrogen in two forms—nitrate nitrogen and ammonium nitrogen—giving a double fertilizer action. The nitrate nitrogen is immediately assimilated by the plant, thus aiding early growth. The ammonium nitrate, which cannot be used by most crops until it has been broken down to nitrate in the soil, provides a reservoir of nitrogen in the soil.

The second advantage is that a higher concentration of plant food can be incorporated in Fisons' compounds, resulting in less bulk and greater flexibility in the composition of compounds containing the three essential plant foods—nitrogen, phosphate and potash.



Ammonia from the new synthetic ammonia plant at adjacent Shell-haven is fed to Fisons factory at Stanford-le-Hope and stored in this 2,000 ton sphere — largest of its kind in Britain — before being converted to ammonium nitrate.

Details of the manufacture of ammonium nitrate by the oxidation of ammonia, obtained from the Shell Chemical Company's new synthetic ammonia plant at adjacent Shell-haven, to nitric acid followed by the neutralization of the acid with more ammonia, have already been published. Just tribute has also been paid to the organization of the self sustaining nitric acid plant with its careful consideration of the plant heat balance and the organization of the distribution system with its special fleet of road and rail tankers.



Altogether 1,500,000 gallons of ammonium nitrate can be stored at Stanford-le-Hope prior to loading in road and rail transport. This storage tank has a capacity of one million gallons. Associated pipe work, pumps and heat exchanges are also shown.

Coincident with the official opening was the announcement that Fisons 42 and Fisons 49 both based on ammonium nitrate have been added to Fisons 40 range of fertilizers; they are both designed to bring about reductions in farmers' fertilizer costs.

It may be remembered that Fisons have pioneered the development of fertilizers containing herbicides and insecticides. 41 plus aldrin is for the control of wireworm in potatoes, and 45 plus aldrin for the control of wheat bulb fly in autumn sown corn.

Boron can be added to 41 and 45 for the control of heart rot disease in sugar beet, swedes, turnips and some other crops.

Publications Received

Techniques for Testing Insecticides.

By J. R. Busvine, Ph.D., D.Sc. Published by the Commonwealth Institute of Entomology, 56 Queen's Gate, London, S.W.1.

This is not the book for the uninitiated nor can it be scanned through in one night, for it covers too wide a field of science and technology from statistics and physics to entomology. The fact that Dr. Busvine has been able to collect his material from such a diverse field enhances his already considerable reputation.

From whatever angle the research worker is interested in the action of chemicals on insects, he will find this an invaluable publication, to be referred to time and again and to be used as a basis for the evaluation of new techniques.

Dr. Busvine has done a great service by collecting this material for he has released the research worker from the exhaustive task of ploughing through a wide field of literature to find a suitable technique for his requirements. Yet by abstaining as far as is possible from expressing his own personal opinions in describing the various techniques he allows the scientist to use his own judgement in comparing them. Only after he has selected tests to fit his requirements may the scientist find it necessary to refer to the original papers and there is an adequate list of these at the end of the book.

The author has not been frightened to use a number of clear diagrams and readers may well find these to be of great assistance.

Due to the diversity of the fields entered it would be impossible to give an adequate description of the subject matter but " The aim," as Dr. Busvine describes it in the introduction, " has been to cover adequately subjects such as the physiological standardisation of the insects and the various types of test method. In most cases, therefore, some discussion of physical, mechanical and chemical factors has been necessary, in an attempt to provide an understanding of exactly what is happening during a test."

The author also states that " The subject is somewhat diffuse, since it extends outside the ordinary entomological publications and it is not possible to claim that the survey of the literature has been exhaustive." Nevertheless, he has covered a remarkably wide field and in view of this his concluding opinion that " Standardisation to some extent is essential if the results of workers in different laboratories are to be entirely comparable and meaningful," merits a great deal of consideration.

Report on Forestry Research, 1958.

Published by H.M.S.O. Price 9s. 6d.

Articles of interest to pest control workers included in this report are: " Preliminary Experiments on the use of Toxaphene and Endrin for the Control of Short-Tailed Voles in Young Forest Areas," by G. D. Holmes, R. M. Brown and R. M. Ure The results of these experiments bear out the encouraging results obtained in similar experiments on the continent. In the section entitled " Nursery Investigations " there are brief reports on the application of various fertilizers, fungicides, pre and post emergence weedkillers, Maleic Hydrazide (as a growth inhibitor) and insecticides. The use of seed dressings is also mentioned.

Forestry workers will, of course, find the other articles, as well as the above of interest.

Formulators Manual.

Published by the African Pyrethrum Technical Information Centre Limited, 4 Grafton Street, London, W.1.

The Formulators' Manual has been issued in order to assist present and prospective manufacturers of pyrethrum based insecticides. The advantages of pyrethrum as an insecticide are mentioned but naturally the majority of the space is devoted to formulation as space sprays, residual films, dusts, water miscible concentrates, etc. the synergism of pyrethrum is also discussed.

Infestation Control.

Published by H.M.S.O.

The foreword to this publication is in keeping with the rest of it, that is, brief and to the point. In the words of Dr. I. Thomas, " This publication outlines the scientific work done in the Ministry of Agriculture, Fisheries and Food on pests of stored products and on harmful mammals. The work is the responsibility of the Ministry's Infestation Control Division at Hook Rise, Tolworth, Surbiton, Surrey, and, in order to put the information into perspective, a brief account of the history and organisation of the Division is given." Dr. Thomas added " More detailed accounts of the specific problems dealt with will be found in the scientific publications listed at the end of this booklet," and although this may be true there is a surprising amount of information in its thirty two pages.

The sections on the " Fumigation of Grain in Bulk," " The Control of Rats in Sewers," " The Biology and Control of House Mice " and the sections concerning the rabbit and wood pigeon problems make interesting reading.

As indicated in the foreword this publication is primarily intended as a guide and as such should be very useful. For more detailed information on any particular point, the publications listed at the end of the booklet will have to be referred to.

Plant Food Review, Spring 1959.

Published by the National Plant Food Institute, Washinton 6, D.C.

A great deal of the space in this issue is devoted to the advantages of soil testing and methods of obtaining soil samples.